"Vandiver, Gary W" <gwvand@solutia.com>

10/15/2003 10 21 AM

To Nabil Fayoumi cc Sandra Bron, "Williams, Richard S", Peter Barrett, "Yare
Subject RE RA at Site R

Nabil,

Here is the technical memo for the slurry wall stabilization. The Mueser Rutledage report will be sent via FedEx today.

Gary

Gary Vandiver
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-----Original Message-----
From: Fayoumi.Nabil@epamail.epa.gov
[mailto:Fayoumi.Nabil@epamail.epa.gov]
Sent: Thursday, October 02, 2003 3:56 PM
To: Vandiver, Gary W
Cc: Sandra.Bron@epa.state.il.us
Subject: RA at Site R

Gary,

I would like Solutia to provide a technical memorandum describing the decision-making process and final outcome of their discussions with Inquip that led to the final decision to raise the ground level and install a series of vertical wick drains to resolve the soft-ground instability issue. The memo should include the results of the geotechnical testing and describe the engineering logic behind the final solution (raising the ground and installing wick drains).

....

Nabil Fayoumi
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Soil Stabilization do

October 15, 2003

Mr. Nabil S. Fayoumi
U. S. Environmental Protection Agency - Region 5
Superfund Division
77 West Jackson Boulevard (SR-6J)
Chicago, Illinois 60604-3590

Re: Trench Excavation Stability Design
Slurry Wall Excavation, Sauget Area 2, Sauget, Illinois

The attached report "TRENCH STABILITY ANALYSIS SUMMARY" prepared by Mueser Rutledge Consulting Engineers ("Mueser Rutledge"), presents a stability analysis for construction of the soil-bentonite slurry wall for the Groundwater Migration Control System (GMCS) at Sauget Area 2. The slurry wall contractor, Inquip, requested Mueser Rutledge to provide design evaluations of stability alternatives.

Preliminary Evaluation of Excavation Stability

In March 2003, Mueser Rutledge performed a stability analysis using information from cone penetrometer and soil boring logs from previous investigations. The analysis determined that the minimum slurry density should be 78 pounds/cubic foot for trench stability. Based on existing information at that time there was no indication that stability issues might arise.

Alignment Survey

Inquip proposed construction with a one-foot thick stone-filled work pad parallel to the trench to support the two clamshell cranes. However, when the track hoe began excavation, the ground surface south of Station 16+00 was observed to compress several inches under the weight of the excavator. Test pits excavated along the barrier wall alignment revealed soft saturated soils containing fly ash with fine sand. It was apparent that some stabilization would be required to assure safety of the excavation personnel and equipment. It was also unknown if trench stability was an issue.

Alternative Designs for Crane Support

Mueser Rutledge was requested to evaluate alternatives for ground improvement below the crane work pads. The alternatives evaluated and a summary of the analysis findings are presented below and in the enclosed report. These alternatives were evaluated with the finite element program, Plaxis.

Following are descriptions of the alternatives considered. Evaluation of these alternatives was an iterative process and the analysis was refined as more information was obtained.

Stone Columns. Three-foot diameter stone-filled columns to a depth of 25 feet beneath each track of the crane, spaced six feet on center. Columns below the rear track (i.e., the track furthest from the slurry trench) would be offset from the columns located below the front track. Analysis indicated stress concentrations would develop in the ground below the crane and below the columns. These stresses were predicted to cause deformation below the columns towards the trench wall.

The use of stone columns in conjunction with a raised work platform and slurry at Elev. +423 and the stone columns extending to a depth of 35 feet was evaluated. The benefit of raising the slurry levels was evident. The added slurry support substantially reduced ground stresses. The stone columns distributed crane loads deep in the profile, which reduced stresses at the trench wall.

Auger-Cast Piles. Piles to about 50-ft depth, which would engage sand to distribute the crane loads, were considered. Pile performance was confirmed by the finite element analysis, but some bulging towards the trench was predicted at the bottom of the piles. However, the three-dimensional effects would likely increase the stability to acceptable values.

Stone or Concrete Filled Trenches. These cases were not formally analyzed, as they were considered similar to the stone column case. Trenches excavated through the fly ash to about the 20-ft depth were proposed. A trench would be placed beneath each crane track, parallel to the barrier alignment.

Concrete filled trenches were acknowledged to reduce ground stresses below the crane, but Mueser Rutledge did not believe that these would change the conditions at the trench wall below the trenches, as identified in the model for stone columns. In addition, there was concern that the rigid concrete face parallel to the slurry trench would be a discontinuity, reducing stability of the soil mass between the trench and the crane.

Raised Slurry Level. Slurry levels may be raised above the existing ground surface by constructing a raised work platform and crane pad. An analysis was performed for a 4-ft increase in slurry head.

Arriving at the Final Design

The improvement offered by raising the slurry head was most attractive, but there was concern that the work platform height needed for the 4–ft. rise would require continuous use of a truck and loading operation to place the backfill into the trench. An ~2.5-foot high work platform was considered feasible because trench-side mixing could still be performed. Slurry level could be raised 3 feet with a 2.5-ft high work platform and the level work platform would provide superior elevation control compared to the ground surface.

Concern that the fly ash could develop excess pore water pressure if the ash particle structure collapsed under the equipment loads and repeated cyclic loading led to the decision to dewater the soft soils area. It was decided to use wick drains to lower the perched water table and control excess pore water pressures. Wick drains were selected because they could be installed quickly and at relatively low cost.

To confirm the acceptability of the design, Mueser Rutledge evaluated trench stability with a raised work platform surface at Elev. +422.5 and wick drains below the work platform. The work pad would be constructed of compacted granular fill, wide enough to support the excavator and the clamshell cranes. Wick drains would be installed on the crane side of the trench below the work platform. The wicks would extend to a 35-ft depth, at ~5-ft spacing.

In order to monitor trench stability during construction, three piezometers and settlement plates will be placed between the trench and the clamshell crane work pad, within the area treated with wick drains

Final Stability Analysis

Analysis of the construction proposal was performed using both the active pressure balance method, and the finite element method. The analysis is presented in Appendix D and summarized in Table 1 in that appendix. The safety factors determined for the crane cases are considered to be conservative because they do not include three-dimensional effects of load distribution and shear resistance.

If you have any questions, please call me.

Sincerely,

Solutia Inc.

Gary W. Vandiver
Project Coordinator

Table 1: Summary of Trench Stability Estimates (Ref: Appendix D)

	Case (Soil Profile)	Friction Angle	Slurry Head	Crane Loading	Active Pressure Method Safety Factor		Shallow Finite Element Method Safety Factor	Notes
					Shallow Wedge at El +380 (40 ft Depth)	Deep Wedge at El +280 (140 ft depth)		
Case 1	General GWT @ El +390	-	El +418	No Crane	1.371	1.506	-	1, 2, 8
				70 Metric Ton	1.159	1.425	-	1, 2, 8
				90 Metric Ton	1.133	1.414	-	1, 2, 8
Case 2	General GWT @ El +400	-	El + 418	No Crane	1.331	1.363	-	1, 2, 3
				70 Metric Ton	1.098	1.280	-	1, 2, 3
				90 Metric Ton	1.075	1.270	-	1, 2, 3
Case 3	Ash Pit γ = 110 pcf With Grid	$\Phi = 22°$	El + 421	No Crane	1.307	1.429	1.454	2, 4
				70 Metric Ton	-	-	1.333	2, 4
				90 Metric Ton	1.197	1.353	1.296	2, 4
Case 4	Ash Pit γ = 90 pcf With Grid	$\Phi = 22°$	El + 421	No Crane	1.594	1.623	1.633	2, 4
				70 Metric Ton	-	-	1.371	2, 4
				90 Metric Ton	1.380	1.526	1.319	2, 4
Case 5	Ash Pit γ = 90 pcf No Grid	$\Phi = 22°$	El + 421	No Crane	1.594	1.623	1.579	2, 4
				70 Metric Ton	-	-	1.283	2, 4
				90 Metric Ton	1.380	1.526	Yield	2, 4, 5
Case 6	Ash Pit γ = 90 pcf With Grid	$\varphi = 16°$	El + 421	No Crane	-	-	1.362	2, 4
				70 Metric Ton	-	-	1.262	2, 4

				90 Metric Ton	-	-	1.223	2, 4
	Ash Pit γ = 90 pcf No Grid	φ = 16°	El + 421	No Crane	1.170 (7)	1.560	1.065	2, 4
Case 7				70 Metric Ton	-	-	Fail at 80%	2, 4, 6
				90 Metric Ton	0.923 (7)	1.463	Fail	2, 4
	Ash Pit 18 ft@110 pcf 17 ft@90 pcf With Grid	18 ft@ φ = 32° 17 ft@ φ = 16°	El + 421	No Crane	-	-	1.585	2, 4
Case 8				70 Metric Ton	-	-	1.422	2, 4
				90 Metric Ton	-	-	1.304	2, 4

cc.	Sandra Bron - IEPA	Steven Acree – USEPA
	Linda Tape - Husch & Eppenberger	Ken Bardo - USEPA
	Mike Coffey - USF&W	Richard Williams - Solutia
	Tim Gouger – USACE	Bruce Yare – Solutia
	Peter Barrett – CH2M Hill	Cathy Bumb - Solutia